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(54) Process for improving the wet hiding power of emulsion paints.

(57) A wet hiding power developing system which does not alter the dry hiding power is introduced into the paint composition. The process is particularly useful for high-pigment emulsion paints which have a dry hiding power higher than the wet hiding power.

The preferred system consists of an acid-base indicator of $pK_a = 6-10$ and having a colourless acidic form, with sufficient basic material to develop the coloured basic form.

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The present invention relates to a process for improving the wet hiding power of emulsion paints, and more particularly to the use of that process for obtaining emulsion paints having substantially equal wet and dry hiding powers.

It is known from Japanese Patent Application nr. 60-170764 (1985, S. Aoyanagi et al. to K.K. Toshiba) that the addition of a basic substance and a color-developing indicator to a varnish allows to improve the application workability, by easily distinguishing the coated portions and the uncoated portions during application, whilst leaving a transparent varnish film after drying. However, both wet (coloured) and dry (transparent) varnish films according to this disclosure show no hiding power.

Many emulsion paints, especially high-pigmented ones, inherently have a lower hiding power when wet than when dry. As a consequence, it is necessary to add an excess of titanium dioxide in order to obtain a sufficient wet hiding power. Titanium dioxide being more expensive than water, there is thus a need in the art for a process for improving the wet hiding power of emulsion paints, more particularly for obtaining substantially equal wet and dry hiding powers.

It is an object of the invention to provide a process to improve the wet hiding power of emulsion paints.

A further object of the invention is to provide a process for obtaining an emulsion paint composition of substantially equal wet and dry powers.

Another object of the invention is to provide emulsion paint compositions having substantially equal wet and dry hiding powers.

The process of the invention for improving the wet hiding power of emulsion paints consists in introducing a wet hiding power developing system which does not alter the dry hiding power.

Emulsion paint compositions essentially consist of a dispersion in water of one or more binders, one or more pigments, one or more fillers, optionally one or more dyes, and generally one or more additives.

As optical properties are related to the volume of the pigment, one of the concepts used in this art is the pigment volume concentration (hereinafter pvc) : the pvc is the volume of pigments and fillers relative to the total volume of the dry paint film. As the pvc increases, a value is reached at which there is insufficient medium to completely surround the particles of pigments and fillers. That concentration is known as the critical pigment volume concentration (cpvc). Low pvc emulsion paints, as used herein, are paints formulated below the cpvc, while high pvc emulsion paints are formulated above the cpvc.

The hiding power of a white paint depends on the scattering of the incident light, which itself depends on the refractive index of the various components involved. The dominant position of TiO₂ (more particularly of the rutile form thereof) as white pigment is explained by its high refraction index of 2.7, to be compared with typical values of about 1.5 for paint binders. Extenders or fillers are defined as having a refractive index similar to typical paint binders, and thus do not contribute to the hiding power in a dry emulsion paint.

In high pvc emulsion paints, water (refractive index = 1.3) present in the wet paint is replaced by air voids (refractive index = 1.0) in the dry film, thereby in most cases causing an increase in hiding power. Thus, those emulsion paints having a wet hiding power below their dry hiding power had before this invention to be formulated with an excess of titanium dioxide over the amount that is required to obtain the desired dry hiding power. The use of this invention is however not restricted to high pvc paints, nor to emulsion paints having a wet hiding power below their dry hiding power.

It has now been found that the wet hiding power of an emulsion paint composition can be increased by introducing therein a developing system which does not alter the dry hiding power.

In a preferred mode for carrying out the process of the invention, there is added to the emulsion paint of which the wet hiding power is to be increased, a small amount of an acid-base indicator, said indicator being colourless when under acid form and having a pK_a value comprised between 6 and 10, preferably between 7 and 9, and sufficient basic material to develop the coloured basic form. The pK_a value is defined as pK_a = - log (H⁺) (A⁻)/(HA) wherein HA and A⁻ represent the acid and basic forms respectively and wherein brackets are used instead of the usual square brackets to indicate concentrations.

As suitable acid-base indicators, there may be cited (ranked by increasing pK_a values) 6,8-dinitro-2,4-(1H)quinazolininedione (yellow when under basic form), m-nitrophenol (yellow), o-cresolphthalein (red), phenolphthalein (pink), ethyl-bis(2,4-dimethylphenyl)acetate (blue), thymolphthalein (blue), and mixtures thereof.

The acid-base indicator concentration and the pH value required in the emulsion paint are easily determined : the intensity of the colour developed depends (i) on the inherent intensity of the colour of the basic form of the acid-base indicator and (ii) on the actual concentration of said basic form, which itself depends on the pH of the paint according to the known equation (A⁻) = 10^{-pK_a}(10^{-pK_a} + 10^{-pH}) = K_a/(K_a + (H⁺)). Typical values of indicator concentration range from 0.001 to 4 wt % (based on the emulsion paint), preferably from 0.01 to 0.3 wt %.

Any basic substance may be used to reach the desired pH value; discolouration of the acid-base indicator

will be caused by the reaction of the basic substance with the atmospheric carbon dioxide (and by evaporation of any volatile basic substance present). As examples of basic substances, there may be cited sodium hydroxide, ammonia, 2-amino-2-methyl-1-propanol, 2-dimethylamino-2-methyl-1-propanol, and mixtures thereof.

In addition to increasing the wet hiding power, the invention also provides emulsion paints which have a colour when wet that is different from their colour when dry (a distinct advantage when the substrate has the same colour as the dry paint). Both advantages require that the intensity of the colour developed in the wet emulsion paint should last sufficiently, else the hiding power of the still wet coating would wrongly appear insufficient while the still wet coating might no longer be distinguished from a substrate of the same colour as the dry paint. Controlling how long the colour intensity (and hence the increased wet hiding power) remains substantially constant is most easily achieved by adjusting the buffer capacity of the basic emulsion paint.

This invention is neither limited to any type of binder dispersion, nor to any type of pigment or filler. It will be further described by way of the following examples which are not intended to restrict the scope of the invention.

15 Example 1 and comparative example A

Two emulsion paints were prepared with the following composition (all figures in wt %) :

| | | |
|----|--|-------|
| 20 | - titanium dioxide powder (rutile form, average diameter 0.0003mm) | 5.00 |
| 25 | - aluminium silicate powder | 4.00 |
| 30 | - chlorite powder | 10.00 |
| 35 | - calcium carbonate powder | 24.00 |
| 40 | - opacity polymer | 5.00 |
| | - acrylic polymer (Repolem TM 2126) as 60% dispersion in water (i.e. 4.80 wt % of acrylic polymer) | 8.00 |
| | - 2-amino-2-methyl-1-propanol | 2.00 |
| | - sodium hydroxide | 0.08 |
| | - water and additives | 41.82 |
| | - phenolphthalein (example 1) or additional water (comparative example A) | 0.10 |

The pH of the paints was of 10.77 (example 1) or 10.80 (comparative example A).

The wet hiding power was determined using the international standard ISO-2814-1973, with the following particulars :

- 45 - Erichsen block applicator model 288/120
- wet layer thickness : 0.15mm
- opacity chart form 2A from the Leneta Company
- wet paint films immediately covered with a clear transparent film
- Macbeth MM 2200 spectrophotometer.

50 The hiding power measurements gave the following results :

| | <u>Example 1</u> | <u>Comp. example A</u> |
|----|------------------|------------------------|
| 55 | wet film | 98.1% |
| | dry film | 98.3% |

Example 2 and comparative example B

Two emulsion paints were prepared with the following composition (all figures in wt %) :

| | | |
|----|--|-------|
| 5 | - titanium dioxide powder (rutile form, average diameter 0.0003mm) | 5.00 |
| 10 | - aluminium silicate powder | 4.00 |
| 15 | - chlorite powder | 10.00 |
| 20 | - calcium carbonate powder | 24.00 |
| 25 | - opacity polymer | 5.00 |
| 30 | - acrylic polymer (Repolen TM 2126) as 60% dispersion in water (i.e. 4.80 wt % of acrylic polymer) | 8.00 |
| 35 | - sodium hydroxide | 0.30 |
| 40 | - water and additives | 43.65 |
| 45 | - phenolphthalein (example 2) or additional water (comparative example B) | 0.05 |

The pH of the paints was of 11.27 (example 2) or 11.31 (comparative example B).
The wet hiding power was determined according to the procedure described in example 1.
The hiding power measurements gave the following results :

| | <u>Example 2</u> | <u>Comp. example B</u> |
|----------|------------------|------------------------|
| wet film | 98.0% | 93.8% |
| dry film | 98.1% | 98.2% |

Claims

- 40 1. Process for improving the wet hiding power of emulsion paints consisting in introducing a wet hiding power developing system which does not alter the dry hiding power.
2. Process according to claim 1, wherein the system consists of an acid-base indicator, said indicator being colourless when under acidic form and having a pK_a value comprised between 6 and 10, and sufficient basic material to develop the coloured basic form.
3. Process according to claim 2, wherein the indicator has a pK_a value comprised between 7 and 9.
4. Process according to claim 2, wherein the indicator is used in an amount of from 0.001 to 4 wt %, based on the emulsion paint.
5. Process according to claim 4, wherein the indicator is used in an amount of from 0.01 to 0.3 wt %, based on the emulsion paint.
- 55 6. Process according to claim 2, wherein the indicator is selected from the group consisting of 6,8-dinitro-2,4-(1H)quinazolininedione, m-nitrophenol, o-cresolphthalein, phenolphthalein, ethyl-bis(2,4-dimethylphenyl)acetate, thymolphthalein, and mixtures thereof.

7. Process according to any one of claims 2 to 6 wherein the emulsion paint is buffered.
8. Use of acid-base indicators having a colourless acidic form and a pK_a value comprised between 6 and 10 to improve the wet hiding power of emulsion paints having a pH of at least ($pK_a - 1$).
- 5 9. Emulsion paint compositions characterized in that they contain an acid-base indicator, said indicator being colourless when under acidic form and having a pK_a value comprised between 6 and 10, and sufficient basic material to develop the coloured basic form.

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EUROPEAN SEARCH REPORT

Application Number

EP 91 87 0173

| DOCUMENTS CONSIDERED TO BE RELEVANT | | | | | | | | | | | | | | | |
|---|---|--|---|-----------------|----------------------------------|----------|-----------|------------|----------|-----------------------------|--|--|---|--|--|
| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5) | | | | | | | | | | | | |
| X | CH-A- 464 415 (M. EBNÖTHER et al.) * Claims * ----- | 1-3, 6 | C 09 D 5/02 C 09 D 7/12 | | | | | | | | | | | | |
| TECHNICAL FIELDS SEARCHED (Int. Cl.5) | | | | | | | | | | | | | | | |
| C 09 D | | | | | | | | | | | | | | | |
| <p>The present search report has been drawn up for all claims</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">Place of search</td> <td style="width: 33%;">Date of completion of the search</td> <td style="width: 34%;">Examiner</td> </tr> <tr> <td>THE HAGUE</td> <td>12-02-1992</td> <td>BEYSS E.</td> </tr> <tr> <td colspan="2">CATEGORY OF CITED DOCUMENTS</td> <td></td> </tr> <tr> <td colspan="2"> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document </td> <td> T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document </td> </tr> </table> | | | | Place of search | Date of completion of the search | Examiner | THE HAGUE | 12-02-1992 | BEYSS E. | CATEGORY OF CITED DOCUMENTS | | | X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document | | T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document |
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